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LIST OF PRIZE WINNERS IN THE PADDY COMPETITIONS HELD DURING THE YEAR 1955-56

I. State Prize — *Yield in lb.*

1. D. Mari Gowda, C/o. Venkate Gowda, Srirampura, K. R. Nagar Taluk, Mysore Dist. .. 12,304-8
2. Patel Chikke Gowda, Rampur, Saligram, K. R. Nagar, Mysore Dist. .. 11,148-8

II. District Prizes

1. Gavi Gowda, Baradenahally, Kanakapura, Bangalore (Bangalore Dist.) .. 10,220-0
2. C. K. Ramanujaiah, Pandavapur Taluk (Mandya Dist.) .. 8,920-0
3. M. H. Deve Gowda, K.R. Nagar (Mysore Dist.) 10,744-0
4. K. C. Venkate Gowda, Kshathuvalli (Hassan Dist.) .. 6,920-0
5. T. V. Narasinga Rao, Tarikere (Chikmagalur Dist.) .. 9,215-0
6. Devaraja Modaliar, Bhadravathi (Shimoga Dist.) .. 7,970-0
7. M. Marappa Gownder, Hiriyur (Chitaldrug Dist.) .. 7,770-0
8. K. Rangappa, Sandur (Bellary Dist.) .. 6,200-0
9. Podu Venkatappa, Byrlapur (Kolar Dist.) .. 6,950-0
10. R. Veerabhadraiah, Akkirampura, Holavanahalli Hobli, Koratagere Taluk (Tumkur Dist.) .. 8,673-0

III. Taluk Prize Winners — *lb.*

Bangalore Circle

1. Ramprasad, Kanakapur .. 9,920
   Linge Gowda, Kanakapura .. 9,920
   (Prize to be distributed in equal proportions)
2. Choode Gowda, Channapatna .. 9,520
3. J. Aswathanarayana Rao, Anekal .. 7,320
4. Venkataswamiah, Nelamangala .. 7,025
5. Gopaliah, Ramanagaram .. 6,880
6. K. C. Ramaiah, Devanahally .. 6,840

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The
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Vol. XXXI *October to December 1956* *No. 4*

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EDITORIAL

On 1st November 1956, the cherished dream of 20 million Kannadigas for a united Kannada State was realised with the formation of New Mysore State comprising the 10 districts of old Mysore, the Dharwar, Belgaum, Bijapur and North Kanara Districts of Bombay, the Raichur, Gulbarga and Bidar Districts of Hyderabad, South Kanara District and Kollegal Taluk of Madras and the Part 'C' State of Coorg.

We wish the new State every success in the great task that lies ahead of us all—the great adventure of building a New India.

EDITORIAL ARTICLE

THE AGRICULTURAL RESOURCES OF NEW MYSORE STATE

M. L. N. Iyengar

The agricultural resources and potentialities of the new State of Mysore are very considerable. With an area of 72,730 sq. miles and a population of 19 million, Mysore occupies only the eighth place among the fourteen reorganised States of the Indian Union. But in respect of the area under cultivation she moves up to the fifth place and is surpassed only by Rajasthan, Bombay and Uttar Pradesh in the cultivated area per head of population. Although the geographical area of Karnatak is only 5·9% of the area of India, Mysore's share of the country's acreage under some food and commercial crops is quite high. 69% of coffee, 35% of ragi, 34% of areca, 18% of chillies, 16% of groundnut, 15% of jowar and coconut, 12·8% of cotton, 11% of tur, and 10% of millet acreage is found in Mysore. She ranks first in respect of coffee, ragi and cardamom, second in areca, coconut and castor, third in jowar, cotton and tobacco, fourth in groundnut and fifth in oilseeds.

In the following table are shown the approximate acreages under some important crops in old and new Mysore with corresponding all-India acreages. These figures mainly relate to the year 1954-55 but in some cases as for Bombay, earlier figures have been taken.

	Bombay Karnatak	Hyderabad Karnatak	Madras Karnatak	Coorg	Old Mysore	New Mysore	Percentage increase	All India	Per cent. of India
Area in sq. miles ..	20,984	14,113	5,351	1,586	33,309	73,000	219	12,69,640	5·9
Population in lakhs ..	49	28	15	2	98	190	193	3,569	5·3
Districts ..	4	3	1	1	10	19	190	..	..
Taluks ..	48	24	6	1	89	166	187	..	..
Cultivated area in thousand acres	..	..	..	..	8,255	25,209	305	3,02,500	8·3
Paddy ,, ..	504	96	573	97	848	2,118	250	74,424	2·8
Jowar ,, ..	3,168	2,373	..	..	897	6,538	729	43,456	15·0
Ragi ,, ..	75	11	4	6	1,894	1,990	105	5,747	35·0
Wheat ,, ..	401	140	..	..	3	544	1,800	26,842	2·0
Bajra ,, ..	621	380	..	..	211	1,208	572	27,350	5·0
Millets ,, ..	233	381	..	..	761	1,375	181	13,680	10·0
TOTAL CEREALS ,, ..	5,263	3,385	579	103	4,614	13,944	302	2,08,823	6·7
Gram ,, ..	183	201	..	..	33	417	1,264	20,991	2·0
Tur ,, ..	179	295	..	..	158	632	400	5,944	11·0
TOTAL PULSES ,, ..	907	999	41	1	1,047	2,195	289	54,004	5·5
Potato ,, ..	2	2	..	..	14	16	114	665	2·4
Pepper ,, ..	2	..	15	13	2	32	1,600	2,082	1·5
Chillies ,, ..	124	51	8	..	82	265	323	1,472	18·0
Tobacco ,, ..	49	1	..	..	34	105	309	860	9·7

Sugarcane	,,	..	36	13	6	..	58	113	195	3,932	2·0
Groundnut	,,	..	851	649	..	..	533	2,033	381	12,647	16·0
Castor	,,	..	7	16	..	..	94	117	124	1,273	9·0
TOTAL OILSEEDS	,,	..	1,164	1,160	2	..	867	3,203	369	291,835	9·4
Cotton	,,	..	1,040	841	..	..	436	2,317	531	18,346	12·8
Coffee		..	..	..	..	51	109	160	147	232	69·0
Cardamom	,,	..	1	..	..	78	25	38	152	..	..
Coconut	,,	..	12	..	54	..	174	240	138	1,577	15·0
Oarnge	,,	..	..	..	..	22	9	31	344	..	..
Areca	,,	..	17	..	23	8	46	87	188	260	34·0
Irrigated area	,,	.	321	109	..	..	1,187	1,617	137	51,751	3·1
Forest area	,,	..	3,104	?	450	331	2,257	6,200	274	115,600	5·4
Food production in thousand tons			Not available				1,199	2,849	238	55,327	5·1
Cattle in thousands		..	1,810	1,302	N.A.	141	4,996	8,247	165	1,55,099	5·3
Buffalo	,,	..	755	309	,,	22	1,204	2,294	190	43,351	5·3
Sheeps & Goats	,,	..	1,124	1,373	,,	..	4,629	7,127	154	85,906	8·3
TOTAL		..	3,689	2,984	,,	..	10,829	17,668	163	2,84,356	6·2
Farms and Stations (No.)		..	15	3	4	3	9	34	377	..	..
Agric. Schools and Colleges		..	5	..	..	..	4	9	222	..	..

The figures are provisional and are more indicative than final. They have been collected from various sources.

A study of this table reveals that with the union of territories from Madras, Bombay and Hyderabad Karnatak and Coorg, the cropping pattern of old Mysore has considerably changed. Ragi has yielded pride of place to jowar as the chief staple. The acreage under jowar, wheat, gram, tur, pepper and cotton is four times the area in old Mysore. The area under cultivation, the acreage under cereals, total oilseeds, groundnut, chillies, tobacco and oranges have trebled. Rice and total pulse acreages have increased by 200%. In other words, both in respect of foodgrains and some important cash crops, New Mysore occupies a comfortable position compared with many other States.

Karnatak is self-sufficient in foodgrains. Against her requirements of 28·3 lakh tons for an adult equivalent of 152 lakh population (80% of the total of 190 lakhs) at 1 lb. per head per day the territories now included in Mysore produced in 1953-54, 28·49 lakh tons. Karnatak also produces large quantities of long and medium staple cotton and oilseeds, more than what the textile and vegetable oil industry in the State can absorb. What she needs to produce in larger quantities to achieve a well-balanced agricultural economy are rice, sugarcane, pepper, cashewnut, ginger and potatoes. Instead of extending the acreage under paddy in view of the current limited irrigation resources and the need for husbanding them for production of commercial crops, measures should be taken to step up the per acre yields. A target of at least 1·5 lakh acres for sugarcane must be set for the next five-year period to feed 4 existing sugar factories and the 3 units to be set up at Kampli, Pandavapura, and Shimoga and also 3 new units so that Mysore may have 10 factories in all. The production of pepper and cashew should be stepped up for earning foreign exchange. Already South Kanara is the leading production centre for cashew and it would be desirable to take special measures for maintaining the lead. The possibilities of expansion of ginger and potato production should be examined. In all these commodities a target of at least 6% of India's current acreage and production must be set.

Although the merging territories are not so rich in numbers as old Mysore was in respect of livestock wealth, the additions particularly in respect of buffaloes is considerable. The Dharwar buffalo also known as Nagpuri or Pandharpuri, though smaller than the famous breeds of North India, is an economic producer and for its size, a good milk yielder. How-

ever, with 18 lakh numbers of cattle, sheep and goats, Mysore is among the leading States in India.

In regard to forests, New Mysore is in the enviable position of having 62 lakh acres or nearly 15% of the land surface under forest cover, the minimum for an agricultural country. She is surpassed only by Assam. It is estimated that Karnatak forests produce about 30% timber and fuel, 15% of forest minor products, 90% of sandalwood and nearly 50% of bamboo produced in Indian forests. North Kanara teak is known to be as good as any produced in the country. Mysore can lead the country in forest management and planned exploitation of forest wealth.

Mysore was already a leading producer of silk. With the merger of Kollegal the State will be the foremost in mulberry cultivation. There are suitable areas in Belgaum and Dharwar where sericulture has already been introduced in 13 taluks and where there is good scope for future development.

Bee-keeping has developed appreciably in North Kanara and Coorg. The Mysore honey is famous for its quality. With sincere and sustained efforts the State may become one of the leading producers of honey.

The 200-mile fish-rich coast on the west is an asset to the State. The two Kanaras provide nearly 10% of the total catch of sea-fish in India. North Kanara has already become the most important fishing district in Bombay. South Kanara has an even better record. According to an expert, "the fisheries round about these districts are comparatively more productive of fish than the Scottish waters which stand high among the best fishing grounds of Europe." The Karnataka region abounds in many inland waters and watercourses and with the introduction of deep sea fishing and planned exploitation of inland waters, Mysore is bound to become one of the foremost producers in the country.

Thus Mysore has abundant wealth and variety of renewable resources like crops, animals, forest and fish.

It has been happily said that Karnatak is essentially a land of promise. This is particularly true of power and irrigation resources. The new territories have added only 4·2 lakh acres to the 11·7 lakh acres of irrigated land in Mysore. In recent years considerable strides have been taken to develop

irrigation in Bombay and Hyderabad Karnatak. The Ghataprabha Project after completion of the storage and channel works is expected to irrigate 4·5 lakh acres in Belgaum and Bijapur. The Thungabhadra Project will bring about 5·8 lakh acres under irrigation in Raichur District by 1958. The low and high level canal is expected to protect about 1·92 lakh acres in Bellary. The Bhadra Reservoir will add another 2 lakh acres. With the completion of all the projects on hand in the course of the next decade the current acreage under irrigation will be doubled.

There are other projects which have not yet been explored in detail. For example, the Upper Krishna Project if feasible, may protect about 17 lakh acres in Bijapur and Gulbarga Districts. Lift irrigation schemes in the Krishna and Bheema Valleys may benefit nearly 2 lakh acres in Bijapur. The Ramadrug Project on Malaprabha may confer protection on 4 lakh acres in Bombay Karnatak. With three big rivers, the Cauvery, Thungabhadra and Krishna, with over 50 small rivers and large number of rivulets criss-crossing the State to a length of 10,000 miles and with a terrain ideal for small irrigation works, Mysore has, one should think, very good irrigation resources. It is said of old Mysore that it would require some ingenuity to discover a site suitable for a new tank; so well have the valleys been utilised. If the same effort is made in other territories that have now united with Mysore, Karnatak would indeed become a blessed State.

The first task, therefore, of the first Karnatak Government should be to institute immediately exhaustive surveys of the agricultural, irrigational, power, mineral and industrial potential of the State and to draw up an outline of development for the next 20 years. One cannot plan effectively without adequate data. The development of New Mysore is both an opportunity and a challenge; opportunity at last for all the Kannadigas to share in the adventure of building the State they have dreamed of for decades and a challenge to the officials of Mysore who have justly been famous for husbanding the meagre resources of old Mysore and developing it into a Model State.

We in Mysore have many blessings. We have a large territory with a small population. We have no space problem as in Kerala, Madras, Bengal and Bihar. We have an equable climate. We have abundant renewable resources. We have a

glorious past. Our people are hard-working, cultured, tolerant, peace-loving and patriotic. May be, we are less resourceful and enterprising than some of our countrymen. We cannot have a monopoly of all the good things of life. But we have the tradition and mental equipment, the resources and means for enriching the material and cultural life of Kannadigas and for contributing to the variety, wealth and glory of this great country.

INFLUENCE OF PHOSPHORUS ON NITROGEN UTILIZATION BY RAGI CROP

By B. V. Venkata Rao and Dr. S. V. Govindarajan[1]

Ragi (*Eleusine coracana*) is the most important food crop in Mysore State, forming the staple food for the majority of the population. Considering its regional distribution, it is found that ragi is mostly confined to this State and over 23 lakhs of acres forming more than 50% of the area under food crops come under this crop every year. Studies on this crop particularly with regard to manuring is meagre, since it is mostly cultivated under rain-fed conditions. Only bulk manures like farmyard manure and compost are applied to the crop under rain-fed conditions owing to the low money value of the crop and uncertain conditions of cropping. Artificial fertilizers are applied and that at moderate doses only when the crop is grown under irrigated conditions. In post-war years, in common with other food crops, the prices of ragi has also gone up and increasing its production through manuring with artificials is an economic proposition which demands earnest consideration. In view of this, studies on the manurial requirements of ragi and also on the influence of various major and minor nutrient elements on the crop, were started a few years ago. This paper deals with the results of an experiment conducted in plots in the pot-culture house for 3 years, on the influence of increasing doses of P_2O_5 over a common dose of N, on the yield and composition of the crop.

It is generally accepted that in some way nitrogen utilisation by cereals is dependent upon the available supply of P_2O_5. Extensive work has been carried out in Europe on phosphate manuring of wheat, barley, oats, turnips and other crops and the need for easily available P_2O_5 at critical periods of plant growth such as rooting, flowering and grain formation is well established. Even in India, experimental results (1940) indicate that the response of paddy to N applications is complete only when it is combined with balanced amounts of P_2O_5. Sen and Sircar (1941) working with wheat report that absorption of N is controlled by the supply of P and the greatest absorption

[1] Division of Agricultural Chemistry Mysore State Department of Agriculture.

was associated with highest levels of P. Earlier work by the authors of this paper (1956) has also shown the necessity of balance between N and P_2O_5 in manuring of paddy and ragi.

Experimental

Ragi was grown in a set of regularly laid one square yard plots, the soil in the plots being typical of the ragi-growing areas in Bangalore District. It is a red sandy loam, nearly neutral in reaction, poor in N and organic matter and rather low in lime and phosphorus. Each plot was planted with 36 ragi seedlings and received uniform cultural operations except for the variations in treatments noted below. Periodical observations on the progress of the crop were made at regular intervals and on harvest the fresh and dry weight of grain and straw for each plot were recorded. The composite samples of grain and straw from the replication of each treatment were taken up and analysed for ash, P_2O_5 and N.

The following were the differential manurial treatments adopted :

40 lb. of N only; no P_2O_5.
40 lb. of N + 10 lb. of P_2O_5.
40 lb. of N + 20 lb. of P_2O_5.
40 lb. of N + 40 lb. of P_2O_5.
40 lb. of N + 80 lb. of P_2O_5.
40 lb. of N + 160 lb. of P_2O_5.

The doses of N and P_2O_5 are per acre, the former being supplied as a mixture of Am_2SO_4 and groundnut cake in equal proportions of N and the latter as superphosphate.

Each of the above treatments were replicated 4 times by randomisation. The cropping was repeated over six seasons and the yield of the crops from each of these trials are set out in Tables I to III. The results of analysis of the N and P_2O_5 are given in Table I and in the increases of these nutrients with the differential treatments over the nitrogen only treatment are worked out in Table III.

Table I

Yields of ragi grain and straw in the experiments

Treatments	Summer 1952		Monsoon 1952		Summer 1953		Monsoon 1953		Summer 1954		Monsoon 1954	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
1	175·5	377·5	184·0	359·0	209·0	370·0	295·0	558·0	269·0	550·0	254·0	337·5
2	188·0	377·5	246·5	520	222·0	410·0	327·0	583·0	302·0	565·5	282·5	350·0
3	190·5	365·0	283·0	597·5	252·0	478·0	345·0	638·0	330·0	662·5	323·5	412·5
4	205	362·5	299·0	619·0	267·0	513·0	335·0	757·0	372·0	702·5	331·0	430·0
5	204	410·0	307·0	625·0	300·0	589·0	371·0	689·0	382·0	725·0	352·0	442·5
6	211	375·0	324·0	629·0	306·0	594·0	387·0	704·0	392·0	779·0	375·0	457·5
Critical difference	N.S.	..	45·8 g.	..	38·0 g.	76·0 g.	32·6 g.	75 g.	47·7 g.	..	56·5 g.	..

(Yields of grain and straw are per sq. yd. and average of 4 replications are given in grams.) N.S. = Not Significant.

TABLE II

Composition of the crop in the several experiments—percentage on even dry basis

Treatments	Summer 1952				Monsoon 1952				Summer 1953				Monsoon 1953				Summer 1954			
	Grain		Straw		Grain		Straw		Grain		Straw		Grain		Straw		Grain		Straw	
	P_2O_5	N	P_2O_5	N	P_2O_5	N	P_2O_5	N	P_2O_5	N	P_2O_5	N	P_2O_5	N	P_2O_5	N	P_2O_5	N	P_2O_5	N
1	0·654	1·24	0·33	0·52	0·64	1·63	0·36	0·36	0·63	1·40	0·31	0·46	0·61	1·54	0·24	0·53	0·69	0·96	0·45	0·45
2	0·697	1·22	0·32	0·53	0·64	1·59	0·24	0·45	0·61	1·41	0·29	0·43	0·65	1·51	0·19	0·50	0·71	1·06	0·39	0·43
3	0·708	0·95	0·31	0·51	0·66	1·60	0·25	0·39	0·62	1·43	0·30	0·47	0·67	1·50	0·23	0·54	0·67	0·96	0·35	0·54
4	0·668	1·02	0·33	0·59	0·66	1·63	0·28	0·38	0·65	1·40	0·34	0·45	0·65	1·55	0·29	0·51	0·64	0·96	0·30	0·60
5	0·667	1·22	0·66	0·59	0·64	1·67	0·32	0·38	0·63	1·40	0·50	0·49	0·66	1·51	0·33	0·57	0·62	0·96	0·38	0·50
6	0·705	1·24	0·52	0·57	0·63	1·71	0·36	0·37	0·67	1·46	0·51	0·51	0·68	1·50	0·42	0·49	0·66	0·93	0·43	0·59

Table III

Amount of N and P_2O_5 in g. removed in the crop from an area of 1 sq. yard

Treatments	P_2O_5 uptak	P_2O_5 Increase over 1	N uptake	N uptake Increase over 1	P_2O_5	Increase over 1	N	Increase over 1	P_2O_5	Increase over 1	N	Increase over 1	P_2O_5	Increase over 1	N	Increase over 1	P_2O_5	Increase over 1	N	Increase over 1
1	1·89	..	4·38	..	1·99	..	4·32	..	2·45	..	4·62	..	3·05	..	5·87	..	4·331	..	5·057	..
2	1·90	0·01	5·16	0·78	2·82	0·83	6·27	1·95	2·55	0·10	4·90	0·27	3·24	0·19	5·86	0·08	4·430	0·099	5·558	0·501
3	2·17	0·28	4·77	0·39	3·35	1·34	6·88	2·56	3·00	0·55	5·86	1·23	3·78	0·74	6·64	0·77	4·532	0·201	6·748	1·691
4	2·00	0·11	5·35	0·93	3·69	1·70	7·11	2·89	3·50	1·04	5·05	0·43	4·21	1·16	7·39	1·42	4·490	0·159	7·789	2·732
5	2·60	0·71	5·61	1·23	3·93	1·94	7·48	3·16	4·78	2·33	7·00	2·41	4·72	1·67	7·87	2·01	5·123	0·793	7·292	2·235
6	3·19	1·30	6·12	1·74	4·27	2·28	7·88	3·56	5·10	2·65	7·49	2·86	5·59	2·54	8·72	2·85	5·937	1·607	8·252	3·195

(10 lb. of P_2O_5 and 40 lb. N per acre are equivalent to 0·938 gm. of P_2O_5 and 3·752 gm. of N per sq. yd.)

Discussion

It is seen from the data that there is a steady increase in yield (Table I) of grain and straw in all the treatments with increasing levels of P_2O_5 and these increases are significant at the 20 lb. and 40 lb. levels. Further increases in crop yield at 80 lb. and 160 lb. level are not commensurate with the increase in the dosage of P_2O_5. The composition of the crop (Table II) does not show any marked variations except for a tendency towards increase in the P_2O_5 content of straw at higher levels of P_2O_5. Possibly the increased absorption of the P_2O_5 as a result of increased availability in the soil, reaches a saturation rapidly in the grain and the subsequent intake is accumulated only in the straw from which it is not translocated. A perusal of the data on the amount of N and P_2O_5 removed in the crop (Table III) shows that the recovery of N steadily increases with increasing levels of P_2O_5 and reaches its maximum at 160 lb. level though the dose of N is constant at 40 lb. in all the treatments thus showing the beneficial influence of phosphate applications on the nitrogen utilization. The recovery of P_2O_5 which ranges between 10-40% at lower levels, falls off at higher levels of application.

Summary

The results of six replications of an experiment conducted in plots to study the influence of increasing levels of P_2O_5 up to 160 lb. per acre on the utilization of N supplied at 40 lb. per acre, by the ragi crop are reported. The yields of ragi grain and straw and also the analysis of the crop with regard to N and P_2O_5 contents are recorded. The amounts of these nutrients removed in the crop from an unit area in the different treatments have been worked out. It is seen that there are steady increases in the yield of crop with increasing doses of P_2O_5 up to 80 lb. level and a tendency towards accumulation of P_2O_5 in the straw with increases in the supply of P_2O_5 to the crop is noticed. The utilization of the applied nitrogen is seen to improve with application of increased doses of P_2O_5 as seen from the recovery in the total crop.

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INSECT PESTS OF COTTON IN MYSORE

By B. M. Maheswariah and Dr. M. Puttarudriah*

Cotton is one of the principal commercial crops in Mysore. Out of a total cultivated area of about 82,54,539 acres in the State, about 4,76,416 acres or roughly 5·78% are annually devoted to this crop from which, on the average a yield of 68,000 bales (400 lb. each) of cotton is produced. Cotton is cultivated mainly in northern and southern taluks of the State where the annual rainfall is between 20" and 40", mostly under rain-fed conditions in black cotton and red soils.

Cotton crop in Mysore is subject to the attack of a number of insects which have not so far assumed the status of serious pests. Names of principal insect pests have been furnished in Table I.

Table I

List of principal insect pests of cotton in Mysore

Sl. No.	Common name of the insect	Scientific name	Order	Family
1	Pink bollworm	*Platyedra gossypiella* Saund.	Lepidoptera	Gelechiidæ
2	Spoted bollworm	*Earias fabia* Stoll.	do	Noctuidæ
3	Spiny bollworm	*E. insulana* Boisd.	do	do
4	Leaf-roller	*Sylepta derogata* Fb.	do	Pyralidæ
5	Green semilooper	*Anomis flava* Fb.	do	Noctuidæ
6	Jassid or leaf-hopper	*Empoasca devastans* Dist.	Rhynchota	Jassidæ
7	Cotton aphis	*Aphis gossypii* Glover.	do	Aphididæ
8	Cotton stem-borer	*Sphenoptera gossypii* Kerr.	Coleoptera	Buprestidæ
9	Stem weevil	*Pempheres affinis* Fst.	do	Curculionidæ
10	Shoot weevil	*Alcides leopardus* Ol.	do	do
11	Red cotton bug or stainer	*Dysdercus cingulatus* Fb.	Rhynchota	Pyrrhocoridæ
12	Dusky cotton bug	*Oxycarenus laetus* Kby.	do	Lygæidæ
13	Mealy bug	*Pseudococcus virgatus* Ckll.	do	Coccidæ
14	Cotton bud moth	*Phycita infusella* Meyr.	Lepidoptera	Pyralidæ
15	Gram caterpillar or American bollworm	*Heliothis obsoleta* F.	do	Noctuidæ
16	Thrips	*Scirtothrips dorsalis* Hd.	Thysanoptera	Thrypidæ
17	Do	*Thrips tabaci* Lind	do	do
18	Cotton woolly mite	*Eriophyes gossypii* (MITE)	Acarina	Eriophyidæ

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The work on the insect pests on cotton was confined mostly to study the incidence of the different insects and in localized areas protection of the crop from the ravages of the pests which assumed fairly serious proportions by routine dusting and spraying operations with standardized insecticides. Observations made in the fields and the remedial measures that are being adopted have been briefly noted here in respect of each principal insect pest of cotton in Mysore State.

Pectinophora (*Platyedra*) *gossypiella* SAUNDERS

A somewhat important pest of cotton. The caterpillar is commonly known as 'Pink Bollworm'. It occurs in Chitaldrug, Mysore, Hassan, Chickmagalur and Bangalore, from June to October, causing shedding of squares and flowers. Caterpillar bores into tender twigs and developing bolls. The attacked bolls are rendered useless. The percentage of attack is found to be from 14·1 to 41·7. While all the varieties are more or less equally susceptible to Pink Bollworm, the Sindhi variety suffers most.

The larvæ are parasitized by *Microbracon gelechidiphagus* Ram, the percentage of parasitisation being 24. They are also parasitised by *Microbracon lefroyi* D. & G. (Braconidæ) and *Bracon* (*Hapobracon*) *kitchenerii* (Braconidæ).

To keep the pest under check, the following measures are recommended : Collecting infested bolls and destroying them; dusting of GAMMEXANE D.025 on developing bolls, selection of healthy seeds for planting.

Earias fabia STOLL. AND *E. insulana* BOISD.

These are major pests of cotton throughout Mysore State. Commonly known as "spotted bollworm". The larvæ feed on cotton bolls and young shoots. At the age of about two months the seedlings are some times severely attacked. The average percentage of attack, irrespective of the variety, is found to be 50, some varieties being almost completely destroyed.

Larvæ of *E. fabia* are parasitised by *Microbracon greeni* Ashmead during November and *M. lefroyi* D. & G. Caterpillars of *E. insulana* are parasitised by *M. lefroyi* D. & G.

Clipping the tender withering and drooping twigs and destroying them; collection and destruction of infested bolls; dusting of GAMMEXANE D.025 on young and tender leaves and bolls;

selection of healthy seeds for planting are recommended for controlling the pests.

Sylepta derogata Fabricius

It occurs throughout cotton-growing tracts of Mysore as a minor pest. The caterpillar is a leaf-roller, sometimes causing appreciable damage.

Its larval parasites are *Microtoridea lissonata* Viereck. (Ichneumonidæ) and *Neopmiploides sylepta* Viereck. (Ichneumonidæ) during November in Chitaldrug.

Dusting Gammexane D.025 on young plants when the first symptoms of rolled leaves are seen; removing all rolled leaves in heavy infested areas and destroying them are some of the control measures that are adopted.

Anomis flava Fabricius

Till recently it was considered to be a sporadic minor pest on cotton. During 1953 in the month of October it occurred as a serious pest on cotton in Davanagere, Chitaldrug and Shimoga. The detailed life-history and habits of *Anomis flava* have been worked out. Under room temperature during November and December the incubation period lasts 4-5 days; 1st instar larval period 6-9 days; 2nd instar 2-6 days; 3rd instar 2-3 days; 4th instar 6-8 days; pupal period 8-9 days. Moths live actively feeding on dilute honey and lay eggs for 12-13 days. Three to four days after the emergence, the female moth begins to lay eggs and the oviposition lasts for 6 to 12 days.

In the field collections 70% of the larvæ are parasitised by *Tachinid* fly parasites and *Apanteles* spp. Attempt to breed the *Tachinid* fly parasites in the laboratory are not successful. In the laboratory fresh eggs are parasitised by *Trichogramma minitum* R. and pupæ are parasitised by *Tetrastichus ayyari.*

The caterpillar is commonly known as "Green Semilooper"; feeds on leaves and defoliates the plants. Dusting of the crops with BHC 10% controls the pest.

Empoasca devastans Dist.

It is commonly known as "Cotton Jassid" or "Cotton Leaf-Hopper" and is a minor pest in Bangalore and Babbur. Sometimes assumes serious proportion. It sucks the sap from the underside of the leaves with the result that the edges of the leaves turn downwards. The fruiting capacity of the attacked plant is very seriously affected.

Spraying either tobacco decoction (1 lb. tobacco in 8 gallons of water + 1/8 lb. soap) or GEIGY'S DDT-GUESORAL 550 (1 lb. in 16 gallons of water) is recommended.

Aphis gossypii GLOVER.

It is met with in all the cotton-growing areas of the State during May to August. The adult is yellowish to dark-green in colour. It is present in colonies on the leaves and on shoots. It sucks plant sap and affect the plant vitality. Young plants suffer much.

Following are the predators, feeding nymphs and adults : (1) *Cœlophora bisellata* Mulsant. var. *nudipennis* Sic.; (2) *Nephus regularis* Sic.; (3) *Pullus xeramphelinus* Muls.; (4) *Pullus* sp. ? *quadrillum* (Mots.); and (5) *Pullus* sp. ? *guimeti* Muls.

Spraying *hongey* oil soap or fish oil soap (1 lb. in 8 gallons of water) or tobacco decoction or FOLIDOL E.605 0·025%; dusting tobacco powder and wood ash (1 : 4) are advised as remedial measures against pest.

Sphenoptera gossypii KERR.

It is a somewhat serious pest of cotton being localized at Babbur Farm and Jaglur Taluk (Chitaldrug Dist.). The larva is a stem-borer commonly known as the "Cotton jewel beetle". It is found to be damaging local cotton plants, sown late in the year. There is a period of over five months between the completion of cotton harvest and the sowing of fresh cotton seeds in black cotton areas. Thorough search in this off-season did not reveal any alternate host plant. Many adult beetles have been noticed feeding in numbers during this season, on the stray leaves of cotton plants of the previous season. No breeding has been found to take place during this off-season.

A Braconid parasite of the larvæ, *Glyptomorpha smenus* Cameron and an egg parasite, *Oœncyrtus* sp. have been reared out.

Pruning the twigs showing wilting and destroying them keep the pest under check.

Pempheres affinis FST.

It is commonly known as "Cotton stem-weevil". It is confined only to T. Narasipur Taluk (Mysore Dist.) in the border of Madras Presidency. It is not found in any other cotton-growing areas of the State. The average incidence of the pest

is found to be 6%. The usual patchy nature of infestation of cotton crop, character of this insect, is clear in the area. Grubs bore into seedlings just at ground level, form galls and destroy the seedlings.

Earthing up along the rows of the seedlings at least twice in the early part of season controls the pest.

Alcides leopardus Oliv.

This weevil is also noticed to affect the leaf-stalks and tender branches of cotton, specially M.A. II and H.190 varieties in T. Narasipur and Honnali. The percentage of attack is high, coming up to about 75. The lateral shoots are tunnelled in the centre, preventing normal growth and formation of flowers and bolls. It is commonly known as "Shoot-Weevil". The pest can be controlled by hand-picking the weevils and clipping the attacked shoots.

Dysdercus cingulatus Fb.

It is commonly known as "Red Cotton Bug" or "Stainer". A common pest of cotton bolls, sometimes causing considerable damage, during June to September. Adults and nymphs suck the sap from the bolls which, if young, remain stunted. The infested bolls open badly and yield worthless cotton. Attacked seeds are worthless for sowing and for oil extraction. Nymphs congregate in freshly opened bolls to suck sap from the seeds.

Same control measures as for pink bollworms are recommended.

Oxycarenus lactus Kby.

It is commonly known as "Dusky Cotton Bug" and is met with in Chitaldrug, Mysore, Hassan, Chickmagalur and Bangalore. Nymphs and adults suck juice from immature seeds which do not ripen, lose colour and remain light in weight. It feeds on gregariously in bolls.

The infested bolls should be shaken over, or plucked and dropped in a vessel containing water with a film of kerosene oil on surface. Same control measures as for pink bollworm are adopted.

Pseudococcus virgatus Ckll.

It is commonly known as "Mealy Bug". It is a minor pest of cotton sporadically occurring throughout Mysore State. It de-saps the plant.

Spraying with a contact insecticide, cutting and burning of badly infested plants are recommended.

~~*Pseudococcus virgatus* CKLL.~~ Phycita infusella Meyr.

It is commonly known as "Bud Moth" and is a minor pest of cotton occurring in Chitaldrug District. It feeds under cover of leaves tied together by silken threads, checking the growth of the plants. Collection and destruction of the withered leaves is advised.

Heliothis obsoleta F.

This is commonly known as "American Bollworm" or Gram Caterpillar. The caterpillars feed on leaves. They seriously injure the developing cotton seeds by biting a hole through the boll.

Spraying young crop with calcium arsenate or dusting infested crop with DDT 5% or GAMMEXANE D.025 reduce the damage by this pest.

Scirtothrips dorsalis HOOD AND *Thrips tabaci* LIND.

They are minor pests of cotton throughout Mysore. Both adults and nymphs damage plants by lacerating tissue and sucking up sap finally killing the attacked shoots or leaf.

Tobacco decoction (1 lb. + 1½ gallons of water + 1/8 lb. soap) spray when used in the early stages of the crop is very effective against these thrips.

Eriophyes gossypii

This is commonly known as "Cotton woolly mite". The mite lives under the tissues of the epidermis of the leaf and causes a growth of dense whitish hairs on both surfaces of leaf and on the stem. The infested leaves are stunted, curling up and becoming hard and crisp. It occurs in Chitaldrug District.

Spraying the affected plants with lime sulphur wash prepared with 1 part of lime, 2 parts of sulphur and 15 parts of water and diluted 8 times again before spraying controls the mite effectively.

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ANABE ROGA OF COCONUT AND ARECANUT PALMS CAUSED BY *GANODERMA LUCIDUM* AND ITS ERADICATION

By N. S. Venkatakrishniah*

The disease known as *"anabe roga"* caused by the fungus *Ganoderma lucidum* (Leys.) Karst. is a deadly one. It is rapidly spreading on both areca (*Areca catechu* L.) and coconut (*Cocos nucifera* L.) palms in gardens situated in the *maidan* and *semi-malnad* parts of the Mysore State. The disease caused by the same fungus is widely spread in the tropics. It is reported to be prevalent in Burma, Malaya, West Indies, Ceylon, Africa, New Guinea and in other countries in the tropical and temperate regions. Butler[2] first recorded the fungus as the cause of root disease in coconut palms in India in 1906. He[2] reports a similar disease known as "Betelnut Plague" prevalent on areca palms in Assam. Petch[4] describes the disease prevalent on coconut palms in Ceylon in 1910. He recommends that dead or badly diseased palms should be removed and that the butt of the stems should be dug out and burnt immediately the symptoms of infection are noticed on the palms. Coleman[3] first studied the disease on areca palms in Mysore in 1909. He conducted a few experiments for the control of the disease in the field. Venkatarau[5] describes the symptoms of the disease on areca palms in Mysore. Venkatarayan[6] studied the biology of *Ganoderma lucidum* on areca and coconut palms. Briton Jones[1] recommends for the control of the disease adoption of measures that will prevent the soil becoming too wet during the rainy seasons and deficient in soil moisture during the summer months in coconut plantations. The recommendations of all the workers is mainly to eliminate infection by the fungus by adopting sanitary measures and to ameliorate soil conditions in order to render impossible the establishment of parasitic relationship between the tree and the fungus even though the fungus may be present in the soil. The disease prevalent on coconut and arecanut palms in Mysore and the measures recommended for its eradication are described in this paper.

The loss due to the disease on areca is greater because of the proximity of the trees in the garden and less in coconut

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gardens where the trees are farther apart. 4 to 10% of the areca trees and 1-2% of coconut trees are lost every year in severely affected gardens. The disease is severe in gardens which are neglected, over-irrigated, badly drained or subjected to periodical flooding. It spreads rapidly in gardens where prompt and necessary attention is not given to remove the badly infected trees, infected stumps, roots and the *anabes* that appear on the trunks. These act as foci of infection in the garden and serve to spread the disease. The infection takes place slowly. It is difficult to make out the disease at the initial stage of infection and the disease will be far advanced in the tree by the time the outward symptoms are manifest. The greatest defect in the treatment of root diseases is the failure of the gardeners to cut and remove the infected trees at the beginning. When once the fungus invades the main stem, it is difficult to save the tree by any treatment of fungicides. Other trees in the vicinity of the garden are also affected by the same disease. Infection has been noticed on *Honge* (*Pongamia pinnata*), Jack (*Artocarpus integrifolia*), Pomegranate (*Punica granatum*), *Poinciana regia* and *Cassia siamea*. These also serve as a source of infection to the palms in the garden.

The symptoms of the disease are similar to those of drought. Infection is noticed on a few trees here and there in the garden. The earliest symptoms of the disease is the wilting of the lower leaves, which turn yellow and hang down vertically accompanied in some cases with the narrowing of the crown. The new leaves become successively smaller in size and pale in colour. The yield is reduced. A slight exudation or bleeding of a sticky reddish juice is noticed in patches on the lower portion of the trunk (Fig. A). This is very characteristic on affected coconut palms. The tops of affected trees gradually dry up. The sporophores (*anabes*) which are the fruiting bodies of the fungus appear at the late stage of infection on the base of the tree and on the infected stumps left in the garden. The disease is mainly a root affection. The fungus invades the tissues in the roots and at the base of the stem. A dark brownish discolouration of the tissue is seen inside when the affected stem and root are split open (Fig. B). The infected portions begin to rot. The roots turn colour, begin to dry and become brittle. The disease spreads partly through the soil from the roots of infected trees to those of healthy trees nearby and partly through air by means of innumerable minute dust-like spores contained in the *anabes*.

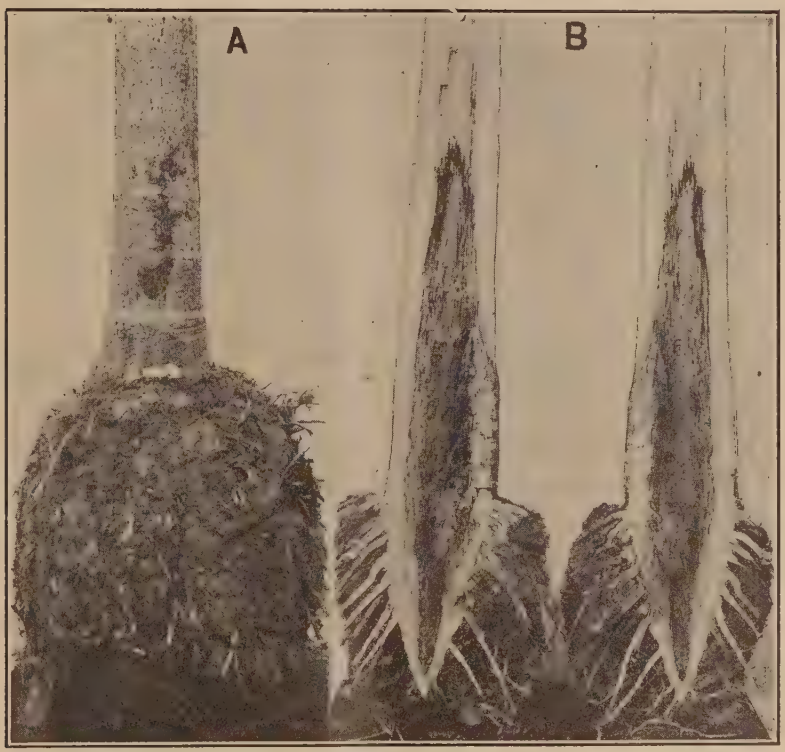

FIG. A—Affected areca stump showing the bleeding on the lower portion of the trunk and the *anabes* on the base of the tree.

FIG. B—Affected stump of areca palm showing brownish discolouration of the tissue inside the stem and roots.

The effective remedy consists in a thorough eradication of all the infective material including the roots and the *anabes* found in the garden. This will prevent further spread of infection to the neighbouring trees. Maintenance of effective drainage, control of over-irrigation or flooding, and proper upkeep of the garden by giving necessary attention to maintain the vitality of the trees in order to resist the infection are important measures to be taken to keep the disease under control. Application of fine sulphur dust to the soil around the trees has given beneficial results. It is very important to eradicate thoroughly the source of primary infection in the garden by removing and destroying all the badly infected and dead trees with stumps and roots complete before taking up any further remedial measures. The gardeners are averse to uproot any infected tree, however severe in infection or poor in yield the tree may be. Only the trunk of the tree that is dead is removed partly. Stumps of the infected trees and the dead roots are all left in the garden for natural decay. The *anabes* are allowed to develop on the trees and stumps in the garden. Some difficulty is also felt to uproot completely the retained stumps in the garden. This enables the fungus to keep alive and to spread to neighbouring healthy trees. Thus the infection is allowed to remain in the garden and is helped to spread to other trees in the area.

Experiments conducted to eradicate the severely affected trees and stumps with two brands of tree-killers, GLOBE and BORGIA, have given promising results. Six to eight small holes are bored with $\frac{1}{2}$″ to $\frac{3}{4}$″ diameter augur in a slanting manner at the base of the trunk near ground level. The holes should be at a distance of about 8″ to 12″ apart and at different levels all round the tree. The holes must be completely freed from wood tissues bored out of the trunk so as to make way for the solution to flow freely inside. These holes are then filled with the tree-killer solution by means of a spirit can or a cycle oil can and plugged with wet earth to prevent cattle from licking it. The tree-killers are very poisonous. Every care should be taken in handling them. It was observed that the trees thus treated dried up slowly in about a month and were easily removed. Their stumps could be extracted *in situ* with greater ease than those of untreated ones. Even partly dried stumps thus treated were easily uprooted after some time. After eradicating completely the foci of infection in the garden, the trees should be treated with fine sulphur of good quality. The soil around the

tree at a distance of 3 ft. away from the base of the trunk is dug out to a depth of about 9" all around and fine, good quality sulphur is evenly spread over in the trench all round at the rate of ½ lb. to 1 lb. per areca palm and 3 lb. to 5 lb. per coconut palm and covered back with the soil. The two treatments, *viz.*, (1) complete removal and destruction of all infected material from the garden, and (2) proper application of sulphur dust to the soil should be done at the initial stage of infection in a systematic way on an extended scale by co-operation of all the gardeners in infected areas. The treatments thus carried out have been observed to prevent further spread of the disease in the gardens and to reduce the infection considerably. In order to impress upon the gardeners the importance of the two methods of control, demonstrations were conducted during the year 1955-56 in both coconut and arecanut gardens in infected areas in the six districts of Chickmagalur, Chitaldrug, Hassan, Mysore, Shimoga and Tumkur. A sum of Rs. 600 was provided for the purpose and each district was allotted Rs. 100 to meet the cost of sulphur and tree-killer. The demonstrations carried out by the Division of Plant Pathology and by the Assistant Directors of Agriculture in the districts have given beneficial results. These demonstrations are continued during the current year in six districts on an extended scale. The Assistant Directors of Agriculture in the districts have been requested to carry out intensive demonstrations on the lines recommended for the eradication of the disease on both coconut and arecanut palms in infected areas under their jurisdiction with the help of the plant protection staff working under them. The allotment under these demonstrations has been increased to Rs. 2,400 during the current year 1956-57 and distributed to each of the six districts as noted below :

1.	Mysore	Rs. 250
2.	Shimoga	Rs. 250
3.	Tumkur	Rs. 450
4.	Chitaldrug	Rs. 450
5.	Chickmaglur	Rs. 500
6.	Hassan	Rs. 500
	TOTAL ..	Rs. 2,400

Experiments with six new proprietary fungicides, *viz.*, ULTRASULPHUR, SOLBAR, DITHANE, CERESAN, MERCURY SPRAY and FERMATE have also been tried on coconut and arecanut palms

in a few affected gardens in Hassan, Tumkur, Chitaldrug and Mysore Districts. The effect of these treatments are under observation.

Two schemes have been drawn up for carrying out large-scale trial of treatments for the control of *anabe roga* of coconut and arecanut palms in Mysore. The schemes have been approved and included under the Second Five-Year Plan and further work is under progress.

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INFLUENCE OF MANURING ON THE YIELD AND COMPOSITION OF PADDY AND RAGI: A STUDY ON THE RECOVERY OF PLANT NUTRIENTS IN THE CROPS

By B. V. Venkata Rao* and Dr. S. V. Govindarajan§

Paddy and ragi (*Eleucine coracana*) are the main cereal food crops in the Mysore State, the former representing about 14% of the total area under food crops and the latter nearly 50% of this acreage. While considerable work has been done on the manuring of paddy in other parts of the country[1] the data available on ragi are not so extensive since it is confined to Mysore State as a major crop and is not a crop of any importance in the neighbouring States where it figures as a minor crop. The field experiments conducted in the pre-war and the war years indicated that a dose of 15 lb. of nitrogen and 12 lb. of phosphoric acid in the form of fertilizers, over a basal dressing of farmyard manure and green manuring supplying another 15 lb. of nitrogen was optimum and economical at the price levels obtaining in those days.

Ragi is largely cultivated as a rain-fed *kharif* crop and, to a lesser extent, as an irrigated crop in both the *rabi* and *kharif* seasons. Bulk manures like compost and farmyard manure are applied exclusively for the rain-fed crop, the use of artificials being rendered risky on account of dependence on rain. For the irrigated crop, a dosage of 15 lb. of nitrogen in combination with 12 lb. of phosphoric acid has been recommended as being optimum.

However, the large increases in the prices of food crops in the recent years and the need for increased crop production have made it possible and also necessary to use larger doses of fertilizers and this in spite of the corresponding increases in the cost of these materials. In view of this, experiments have been undertaken by us during the past few years to study the influence of application of nitrogen and phosphorus in icreasing doses on the yield and also the composition of the crops, both on small-scale in plots attached to the laboratories and on large-scale in fields at the several experimental farms of the State. The crops from small-scale experiments were analysed in par-

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ticular for their content of nitrogen and phosphoric acid and the recovery of these elements from the total crop correlated with the quantities of nutrients supplied in the different treatments. This paper deals with the data obtained from these plot experiments.

In conformity with the results obtained in other parts of the country, these experiments show that under a variety of soil conditions, paddy responds readily to nitrogen applications, while phosphate has but little influence on the yield unless the nitrogen supply is also increased in proportion and that up to certain limits. In spite of this lack of response, application of phosphate is considered beneficial in helping to maintain a balance between the nutrients besides having a direct influence on proper root development, facilitating establishment of a proper stand, and aiding the setting of flower and seed formation. The literature on the effect of phosphates on cereals like wheat and barley and other crops like cotton is fairly extensive while those on paddy are meagre. Noll[2] reports earliness in the maturity of wheat and cotton with phosphate applications, and De Turk[3] considers that the increased yields of wheat with superphosphate applications are due mainly to the larger number of spikelets per head and more seeds per spikelet. While work on paddy is briefly reviewed by Sethi,[1] no published data exist on the response of ragi to manurial treatments.

Experimental

Paddy was grown in soil confined in bottomless cement cisterns, sunk into the earth, square in shape with sides one yard in length and depth of 1'. The soil was typical of the tank-irrigated paddy soils of Bangalore District. The treatments were randomized and replicated five times, the crop in each treatment being grown in separate cisterns. Each cistern was planted with 36 paddy seedlings at the rate of 1 seedling per hole and all the cisterns received uniform basal dressings and cultural operations. Periodical observations on the progress of the crop as measured by tillering and stand of crop were recorded at fortnightly intervals. After harvest the fresh and dry weights of grain and straw were recorded, the bulked samples from each treatment being collected for analysis.

The following were the treatments for paddy :

(A) N + P; (B) 2(N + P); (C) 3 N + 2 P; (D) 3(N + P); (E) 2 P applied at planting and $1\frac{1}{2}$ N applied at the end of 4 weeks and $1\frac{1}{2}$ N at the end of 6 weeks after planting.

N represents 15 lb. of nitrogen as ammonium sulphate per acre.

P represents 15 lb. of phosphoric acid as superphosphate per acre.

Ragi was grown on plots, each 3 square yards in area under semi-irrigated conditions. The different treatments in this case were as follows :

(A) N + P; (B) 2(N + P); (C) 3(N + P).

N represents 10 lb. of nitrogen as ammonium sulphate per acre.

P represents 6-2/3 lb. of phosphoric acid as superphosphate per acre.

Each treatment was replicated 4 times by randomization.

TABLE I

Yield data of the experiment in monsoon 1950

(Crop : paddy)

Treatments	Grain	Straw	% increase of grain over A	% increase of straw over A	Weight per earhead in gm.	Straw/ Grain
A – N+P ..	1535	2790	..	..	1·367	1·818
B – 2 (N+P) ..	1735	2010	13·0	8·0	1·511	1·736
C – 3N+2P ..	1751	3410	14·0	22·0	1·387	1·843
D – 3 (N+P) ..	1846	3240	20·0	16·0	1·531	1·754
E – 2P at planting + 1½ N at 4 weeks+1½ N at 6 weeks	1933	3400	26·0	25·0	1·518	1·810

TABLE II

Yield data of the experiment in summer 1951

Treatments	Grain	Straw	% increase of grain over A	% increse of straw over A	Weight per earhead in gm.	Straw/ Grain
A – N+P ..	2200	3030	..	..	1·18	1·377
B – 2 (N+P) ..	2482	3160	12·8	4·3	1·291	1·273
C – 3N+2P ..	2510	3480	15·0	14·9	1·136	1·376
D – 3 (N+P) ..	2810	3600	32·3	18·8	1·322	1·295
E – 2P at planting and 1½ N at 4 weeks and 1½ N at 6 weeks after planting	3056	4630	39·0	52·9	0·980	1·662

TABLE III

Yield data of the above experiment in monsoon 1951

Treatments	Grain	Straw	% increase in grain over A	% increase in straw over A	weight per earhead in gm.	Straw/ Grain
A – N + P ..	1830	4110	..	..	0·642	2·25
B – 2 (N + P) ..	2150	4700	17·4	14·4	0·685	2·19
C – 3N + 2P ..	2495	5650	36·3	37·5	0·775	2·26
D – 3(N + P) ..	2760	5870	50·8	42·9	0·798	2·13
E – 2P at planting + 1½ N at 4 weeks + 1½ N at 6 weeks after planting	2700	6000	47·5	46·0	0·755	2·22

TABLE IV

Composition of the paddy crop in summer 1951 experiment

Treatments	Grain			Straw		
	% Ash	% P_2O_5	% N	% Ash	% P_2O_5	% N
A ..	1·10	0·484	1·581	9·24	0·289	0·651
B ..	1·10	0·507	1·600	9·08	0·304	0·613
C ..	1·11	0·486	1·627	8·96	0·281	0·587
D ..	1·04	0·517	1·591	8·68	0·310	0·591
E ..	1·12	0·522	1·664	8·24	0·291	0·622

TABLE V

Composition of the crop in monsoon 1951 experiment

Treatments	Grain			Straw		
A ..	1·21	0·550	1·590	8·48	0·310	0·577
B ..	1·20	0·535	1·627	8·42	0·321	0·612
C ..	1·15	0·559	1·629	8·84	0·327	0·522
D ..	1·19	0·527	1·595	8·72	0·315	0·660
E ..	1·21	0·534	1·655	8·92	0·296	0·634

Table VI

Amount of plant nutrients in the crop from 1 sq. yd. in the above experiment

Treatments	Summer 1951				Monsoon 1951			
	P_2O_5 in gm.	% increase over A	N in gm.	% increase over A	P_2O_5 in gm.	% increase over A	N in gm.	% increase over A
A ..	3·30	..	8·43	..	3·16	..	8·53	..
B ..	4·54	37·4	10·37	22·9	3·58	13·4	9·11	6·8
C ..	5·54	67·7	11·26	33·6	3·58	13·4	9·42	10·4
D ..	5·62	70·2	13·56	60·7	4·22	33·7	10·36	21·4
E ..	5·45	69·0	13·50	60·1	4·78	52·1	12·47	46·2

Table VII

Recovery of nutrients in the crop due to increases in fertilizer dosages

	Treatments	Summer Experiments		Monsoon Experiments	
		N in gm.	P_2O_5 in gm.	N in gm.	P_2O_5 in gm.
1	Increase for 1st N + P ..	1·94	1·24	0·58	0·42
2	Do for another N alone ..	0·89	1·00	0·31	0·00
3	Do for 2nd N + P ..	3·19	1·08	1·25	0·64
4	Do for P alone ..	2·33	0·08	0·94	0·64
5	Do for divided dose of the same amount of N as in 2	2·24	0·09	3·05	1·20

(A dose of 15 lb. of N and 10 lb. of P_2O_5 per acre is equivalent 1·41 gm. of N and 0·938 gm. of P_2O_5 per sq. yd. respectively.)

Discussion

From a study of the yield of paddy over the three cropping seasons (Tables I, II and III) it is seen that there is a steady rise in the yield of paddy in both the control and experimental plots indicating a general rise in fertility level. The figures for percentage increase in grain and straw, weight per earhead and ratio of straw to grain point generally to increased

grain formation when phosphorus, in suitable adequate proportions is present, while the vegetative growth appears to be encouraged by increasing nitrogen preferentially or applying it at critical periods to render it more readily available to the crop in the absence of corresponding increase in the dosage of phosphorus. Though the variations (Tables IV and V) due to different treatments on the composition of either grain or straw are only slight, the amounts of plant nutrient elements removed (Table VI) by the crop from at the higher doses is quite high, both with regard to N and P. The recovery of nitrogen and phosphorus in the crop for each successive increase of nitrogen and phosphorus treatment is worked out in Table VII. It is seen that where nitrogen is given in combination with phosphorus, the latter nutrient is fully absorbed by the crop, and that this utilization is less effective when nitrogen is not given. Phosphorus in combination with nitrogen enhances

Experiments with Ragi

Table VIII

Experiments on the effects of increasing doses of N and P on ragi in plots in the pot-culture house

Seasons	Treatments	Grain	Straw	% increase in grain over A	% increase in straw over A	Wt. in gm. per earhead	Straw/ grain
Monsoon Season 1950	A – N + P	1816	2440	..	..	2·05	1·344
	B – 2 (N + P)	2398	3050	32·0	25·0	2·45	1·272
	C – 3 (N + P)	2775	3490	53·0	43·0	2·63	1·258
Summer 1951	A – N + P	1726	3720	..	..	1·71	2·1
	B – 2 (N + P)	1890	4010	9·6	7·8	1·72	2·1
	C – 3 (N + P)	2084	4160	20·8	11·8	2·09	2·0
Monsoon 1951	A – N + P	2625	4100	..	..	2·31	1·6
	B – 2 (N + P)	3285	4980	25·2	21·5	2·52	1·5
	C – 3 (N + P)	3858	5500	47·4	34·1	2·61	1·4

(The yield of ragi grain and straw are in grams from an area of 12 sq. yards and total of 4 replications.)

N = 10 lb. of N as Am_2SO_4 and P = $6\frac{2}{3}$ lb. of P_2O_5 as superphosphate per acre.

the nitrogen uptake, to a much greater extent than when the nitrogen dosage is applied alone. These experiments clearly bring out the important fact that though the crop yields may not increase progressively with increased fertilizer application, the added nutrients are recovered in a large measure by the crops and that where N and P are in balanced proportions, the recovery of both nitrogen and phosphorus are much better than when such a balance does not obtain.

TABLE IX

Composition of ragi grain and straw in the above experiment

Season	Treatments	Ragi grain			Ragi straw		
		% Ash	% P_2O_5	% N	% Ash	% P_2O_5	% N
Summer 1951.	A	2·77	0·668	1·256	6·48	0·262	0·577
	B	2·82	0·656	1·275	6·07	0·256	0·491
	C	2·80	0·666	1·285	6·02	0·205	0·491
Monsoon 1951	A	2·74	0·691	1·182	6·20	0·252	0·567
	B	2·67	0·664	1·202	6·04	0·204	0·532
	C	2·69	0·651	1·243	6·28	0·254	0·491

TABLE X

Amount of N and P_2O_5 in the crop (grain + straw) from 1 sq. yd.

Treatments	Summer 1951				Monsoon 1951			
	P_2O_5 in gm.	% increase over A	N in gm.	N increase over A	P_2O_5 in gm.	% increase over A	N in gm.	% increase over A
A ..	1·744	..	3·597	..	2·376	..	4·531	..
B ..	1·885	6·3	3·664	1·3	2·667	12·3	5·502	21·4
C ..	1·870	5·4	3·946	9·6	3·115	28·1	6·253	38·0

The yields of ragi indicate a general rise in all the treatments over 3 seasons. The percentage increase in the yield of grain and straw, the weight per earhead, and the ratio of straw

Table XI

Increase in nutrients removed in the ragi crop due to increased dosages

Treatments	Summer crop		Monsoon crop	
	N in gm.	P_2O_5 in gm.	N in gm.	P_2O_5 in gm.
1st N+P ..	0·067	0·141	0·971	0·291
2nd N+P ..	0·282	0·015	0·751	0·448

(A dose of 10 lb. of N and 6⅔ lb. of P_2O_5 per acre is equivalent to 0·938 gm. of N and 0·626 gm. of P_2O_5 Per acre.)

to grain reveal the tendency towards increase in grain formation in preference to straw. The influence of phosphorus on the yield appears to be more apparent at the higher dosage of the fertilizers rather than at the lower dosage. Manuring does not appear to influence the composition of ragi grain to the extent that they do with paddy, only slight increases in nitrogen contents being noticed. The phosphorus percentage appears to be fairly steady. In the case of straw with increasing fertilizer applications, the percentage content of both these nutrients appear to be diminished. An examination of the recoveries of nitrogen and phosphorus (Tables X and XI) from the added fertilizer applications indicate that the monsoon crop is able to recover the added nutrients much better than the summer crop. These recoveries however are less effective than in the case of paddy and the indications are that the concentration of these nutrients in the soil solution and also their mobility as measured by the moisture conditions of the soil have much to do in enabling the crops to utilising the added nutrients. The great difference between the uptake of nutrients in the summer and the monsoon crops would appear to strengthen this observation.

Summary

Cereal crops in general are found to respond readily to nitrogenous fertilizers, while the response to phosphates have not been so general and at times negative. In this paper the results of six experiments in plots with varying doses and combinations of nitrogen and phosphorus on paddy and ragi are reported. The analysis of the crop for ash, phosphorus and nitrogen in the several treatments in the different experiments

have also been carried out. The percentage increases in grain and straw, weight per earhead and the ratio of straw to grain generally indicate that phosphorus has a favourable influence on grain formation as against the purely vegetative growth induced by increasing nitrogen as such or applying it at optimum periods to render it more easily available to the crop in the absence of corresponding increase in the dosage of phosphorus. The recovery of the added nutrients is considerably influenced by the proper combination of fertilizers ; phosphorus given in combination with nitrogen aids much better uptake of nitrogen than when the extra phosphorus is dropped out. The nitrogen appears to have a similar complementary influence on the phosphorus uptake. Thus the mutual interrelationship of the two elements is brought out and the need for adequate balance between these two nutrients for optimum crop yield and maximum recovery of the nutrients is thus stressed. The recovery of the added nutrients in ragi is much less complete than in the case of paddy, and the indications are that the moisture relationships of the soil and crop have a considerable influence on the uptake of the added nutrients.

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EMERGENCY CATTLE FEEDS

By H. S. Lakke Gowda*

Statistical evidence obtained during the last few years clearly depicts the picture that majority of our livestock population in the State is undergoing a process of slow starvation, and underfeeding is apparent from the slow rate of growth, late maturity, long, dry periods and low yield of milk, when compared with other countries. The fodder position of the State as given in the *Annual Report of the Department of Animal Husbandry for the year* 1950-51, is as follows :

Nutrients	Dry matter (Tons)	Digestible crude protein (Tons)	Starch equivalent (Tons)
Total Required ..	1,24,77,120	2,95,253	48,11,048
Total Available ..	90,29,095	43,654	27,90,408
Net Deficiency ..	34,48,025	2,51,599	20,20,640
Percentage Deficiency ..	27·63	85·21	42·00

This clearly reveals the fodder position of the State during normal days of rainfall. The deficiency of dry matter is about 27·63% and starch equivalent is about 42·00% and the deficiency of digestible protein is as high as 85·21%. But when there is a failure of monsoon or if there happens to be drought condition in some parts of the State, the position becomes still worse. The unfavourable seasonal conditions during the past few years have reduced the supply of fodders and it has been found necessary to supplement the scanty stocks in the villages in every manner possible. Due to the famine condition it is quite possible that most of the good cattle had to be transferred to other places or sold at a ridiculously low rate in 1953. Heavy mortality due to starvation and malnutrition is also very common. Even if a few animals survive they will be reduced to such a poor condition that they will not be of any use at all, due to continued deficiency of one or the other nutrients.

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The occurrence of such scarcity conditions is purely of Nature's gift, but attempts must be made particularly by the nutrition workers to avert or to mitigate their consequences on the livestock population which is the backbone of our agricultural operations. The question of keeping these plough bullocks and breeding cows alive, during these lean periods is one of the main duties of the nutritional workers. An attempt has been made in this direction to find out new sources of fodders which may be substituted or supplemented in rations of livestock, without any ill-effects and at the same time keeping the animals healthy and productive. During these investigations, search was made for the possibility of utilisation of certain waste products or by-products of a factory or an industrial concern or even weeds or any other vegetative or xerophytic shrubs or plants, which have not been used hitherto as cattle feeds. Among the most interesting things we obtained are sugarcane bagasse, rain tree pods,[1] *Thangadi Kayi*,[2] prickly pear[3] and banyan[4] tree leaves. The percentage chemical composition (on dry basis) of some of these stuffs, so far analysed, is given in Table I.

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[1] *Pithecolobium samar.*
[2] *Cassia auriculata.*
[3] *Opuntia dillenii.*
[4] *Ficus bengalensis.*

Table I

Name	Crude Protein	Crude fibre	Soluble carbohyd-rates	Total car-bohydrate	Crude Fat	Total Ash.	CaO	P_2O_5	MgO
Sugarcane Bagasse ..	0·20	43·00	54·36	97·36	0·64	1·80	0·24	0·14	0·19
Darbe Hullu (Jungle grass) ..	6·25	28·72	53·60	82·32	2·30	9·13	1·39	0·37	1·18
Thangadi Kayi (Young) ..	17·50	21·94	50·85	72·79	2·56	7·15	0·97	0·77	0·52
Thangadi Kayi (Ripe) ..	12·80	29·61	48·28	77·85	2·31	7·04	1·25	0·70	0·77
Rain Tree *Kayi* ..	18·31	21·52	51·45	72·97	2·13	6·59	1·21	1·08	..
Seeme chujjalu Kayi[5] ..	11·01	41·60	41·44	83·04	1·56	4·39	0·58	0·48	0·23
Prickly Pear ..	13·60	11·09	..	..	1·25	..	2·47	1·03	1·44
Banyan tree leaves ..	11·01	27·51	48·52	76·03	1·96	11·00	2·15	0·39	0·61
Jali leaves[6] ..	10·78	..	..	..	..	..	2·91	0·46	1·05

[5] *Albizzia amara*
[6] *Acacia arabica.*

It is generally known that there is an yield of about 25-30% of bagasse from the raw sugarcane. The Mandya Factory alone is producing annually about 60,000 tons of bagasse. This stuff, though contains all the other constituents, except the juice of the raw sugarcane, is used at present only as a fuel. After obtaining a representative sample from the Mandya Sugar Factory, it was offered to cattle and they hesitated to take it in the beginning as it is the case with any new feed. But when fed mixed with other feeds like cereal straws, they relished it. If the animals happened to be still stubborn in not eating it, the best way to induce is to judiciously starve them for a day or two. During famine, the animals are already starved and they will easily take to bagasse which is slightly sweet, if fresh. Chemically bagasse consists largely of cellulose and pentosons, which are complex sugars and it is related to cereal straws. It is industrially used for many purposes in foreign countries. The percentage composition of bagasse, when compared with the common cereal straws of the State, is given in Table II.

TABLE II

Feed	Crude protein	Total carbohydrates	CaO	P_2O_5	MgO
Sugarcane Bagasse	0·20	97·36	0·24	0·14	0·19
Rice Straw ..	2·92	78·94	0·40	0·18	0·26
Ragi Straw ..	3·69	87·31	1·11	0·16	0·43
Jola Straw[7] ..	3·28	83·72	0·35	0·19	0·35
Wheat Straw ..	3·28	83·80	0·38	0·15	0·18

Work has been done at Izatnagar by Kehar (1944 & 1948) about the usefulness of groundnut husks and other useful and hitherto unused waste jungle grass (*Kans, Munj*) as cattle feeds. By the chemical composition, it can be stated that bagasse can be very well compared with any of the cereal straws. Though there appears to be very poor percentage of protein in bagasse, this class of feeds, as a whole, does not contain any digestible proteins. Due to high carbohydrate content it will serve as a very good energy food and this can overcome the deficiency of total dry matter.

[7] *Sorghum vulgare.*

The deficiency and insufficiency of protein is another important problem to be faced and certain tree pods like Rain Tree *Kayi* and *Thangadi Kayi,* contain very good amount of proteins. Kehar *et al.* (1945 to 1946) conducted extensive investigations at Izatnagar on some of the protein-rich substances like mango seed kernel, *jali* pods, entrails, jaman[8] seeds, etc., and all these have been proved to be very good protein feeds for cattle. Under these circumstances, we can say with little doubt that some of these tree pods can be fed to the animals in case of emergency. Rain Tree pods are readily eaten by cattle and it is estimated that one tree can yield an annual production of about half-a-ton. This amounts to about thousands of tons of these pods which is really a valuable feeding stuff. If it can be so organised to collect these pods for the purpose of cattle feeding, it will go a long way to solve the protein deficiency of the State. The percentage composition of Rain Tree pods are herewith given in Table III and compared with other common concentrate feeds.

TABLE III

Feeds	Crude Protein	CaO	P_2O_5
Rain Tree pods ..	18·31	1·21	1·08
Cotton seeds ..	18·02	0·68	1·62
Rice bran ..	10·41	0·21	5·69
Wheat bran ..	9·31	0·23	1·07
Gram husks ..	6·00	0·34	0·56
Kulthi (Horse-gram) ..	22·92	1·23	0·53
Groundnut cake ..	51·75	0·39	1·28

Leaving apart some of the oilcakes like groundnut oilcake, *Til*[9] cake, etc., the rain tree pods are in no way inferior to other feeds of this category in their percentage composition. Adding to it, cattle relish these pods and readily eat them and hence it is a useful supplementary feed to overcome the deficiency of digestible crude protein and particularly so during famine conditions.

It is well known that the problem of cattle nutrition in the State is not only of energy and protein supply, but also

[8] *Eugenia jambolana.*
[9] *Sesamum indicum.*

of minerals and vitamins. It can be considered that some of the tree leaves are of some help to us in this direction. A number of tree leaves were analysed in the laboratory and some of them are rich in proteins and minerals particularly of calcium and phosphorus, the most important minerals. If the leaves of these trees are fed, when they are green, they not only supply important minerals but also vitamin 'A' in the form of carotene, the precursor of vitamin 'A'.

Most of the trees shed their leaves just at the close of winter or just at the beginning of summer, thus giving fresh and tender leaves by the onset of summer, when no trace of green grass will be available anywhere in the State. Work has been done at Izatnagar on some of local tree leaves and they found them to be very useful cattle feeds. In Table IV is given the percentage chemical composition of certain common useful tree leaves of the State along with some grasses for comparison.

TABLE IV

Feed (Green)	Crude Protein	CaO	P_2O_5	MgO
Banyan tree leaves ..	11·01	2·15	0·39	0·61
Peepul[10] tree leaves ..	10·50	0·91	0·41	..
Neem[11] tree leaves ..	14·31	1·20	0·37	..
Jali tree leaves ..	10·78	2·91	0·46	1·05
Garike[12] grass ..	15·42	0·60	0·35	0·96
Karada[13] grass ..	9·58	0·61	0·76	0·53
Shunti[14] grass ..	19·68	0·66	0·80	0·88
Rhodes[15] grass ..	10·53	0·82	0·93	0·47
Guinea[16] grass ..	6·98	0·69	0·72	0·54

In addition to these, the thorny shrub, prickly pear, which is commonly found throughout the State, can be used as a cat-

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10 *Ficus religiosa.*
11 *Azadirachta indica.*
12 *Cynodon dactylon.*
13 *Heteropogon contortus.*
14 *Panicum repens.*
15 *Chloris gayana.*
16 *Panicum maximum.*

tle feed after removing the thorns. The percentage chemical make-up of the same is already given. Owing to its succulent nature, it will prove to be a useful cattle feed at times of emergency.

The recommendations and suggestions made in this report, regarding the supplementation of the existing feeds, are only based on the chemical make-up of the feeds so far examined, but they are to be confirmed subsequently by feeding experiments. Meanwhile they can be successfully tried. They will be very useful during the drought and scarcity conditions such as the conditions that are now existing in some parts of the State. All these above-mentioned feeding stuffs are new to the field of animal nutrition, untapped and unexplored all these days, and possibly very useful stuffs. These can be fed only as supplementary feeds in case of emergency and drought conditions and they cannot be taken as complete feeds for themselves.

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SOME OBSERVATIONS ON THE LIFE-HISTORY AND HABITS OF *ANOPLOCNEMIS PHASIANA* FABRICIUS

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Introduction

Anoplocnemis phasiana Fabricius occurred as a serious pest of grape vine and brinjal[1] in Bangalore District causing damage to tender shoots during May 1954. Cameron was the first to obtain it in Bangalore (Distant, 1902). Subramaniam (1922) also noted it as a minor pest on red gram,[2] egg plants[1] and grape vine. Usman and Puttarudriah (1955) recorded *Pongamia pinnata* as an additional host.

Nature and Extent of Damage

Newly-hatched nymphs are found in large numbers congregating on the host plant and cause severe damage by continuously sucking the sap by inserting their sharp proboscis. As they grow, they scatter but continue to suck the plant sap. The adult bugs cause similar damage, and it is a common sight to see bugs with their beaks inserted and stuck into the tender shoots. As a result of continuous and copious drainage of sap, the young shoots wither, droop and turn black, and the leaves become turgid, rough to touch and finally dry up. In case of severe infestation, the growth of the plant is retarded and the entire plant wilts and withers due to heavy drainage of sap.

When it appeared on grape vine and brinjal in a serious form, it necessitated the cultivators to take up effective control measures to protect the vines in the grape gardens and brinjal crops in the fields.

Taxonomy and Synonymy

The genus *Anoplocnemis* was erected by Stal in 1873. The species *Phasiana* was originally included under the generic name *Lygœus* by Fabricius (1781) and transferred under *Anoplocnemis* by Distant (1900). It belongs to Division *Mictaria,*

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[1] *Solanum melongena.*

[2] *Cajanus cajan.*

Subfamily *Coreinæ*, Family *Coreidæ*, Sub-order *Heteroptera* and Order *Hemiptera*.

Synonymy is as follows:

Anoplocnemis phasiana, Fabr. (Lygæus) Spec. Ins. ii, p. 362 (1781); Dist. A.M.N.H. (7) Vi, p. 373 (1900), id. P.Z.S. (1901), p. 327.

Lygæus grossipes, Fabr. Syst. Rhyng., p. 205, 11 (1803).

Cerbus tumidipes, Herr-Sch. Wanz. Ins. vi, p. 54, F. 614 (1842).

Mictis punctum, affinis, bicolor. Westw, in Hope Cat. ii, p. 10 (1842).

Mictis dubia, castanea, lata. Dall. List Hem. ii, pp. 389 and 390, 13, 14, 15 (1852).

Mictis ferrifera, Walk Cat. Het. iv, p. 24, 57 (1871).

Physomerus mictiformis, Walk Cat. Het. iv, p. 61, 8 (1871). Stoll, Pun. ff. 68 and 69.

Common Names

This insect is known as '*Legume-Pod bug*' since it commonly occurs on leguminous plants. It is also known as '*Paddle-legged bug*' on account of stout and curved hind pair of legs.

Distribution

It is a widely distributed species occurring in India, Burma, Ceylon and Malaya (Distant, 1902). It is recorded also from Java (Miller, 1931). According to Lefroy (1909) it is the commonest species in India, mainly in the localities and is found rarely in the plains.

Host Range

In India, Lefroy (1909) states that it is said to live on *Erythrina* and occurs also on shrubs and grass in many parts where the vegetation is sufficiently abundant. Fletcher (1914, 1917 and 1919) added brinjal (*Solanum melongena*), red gram (*Cajanus cajan*), green gram (*Phaseolus radiatus*), *jola* (*Sorghum vulgare*), *avare* (*Dolichos lablab*) and *Odina wodier* as its food plants and says that this is a specific pest of young *Erythrina* trees. It has been noted in small numbers on indigo at Cawnpore and this insect has been bred on *Sesbania ægyptiaca* at Pusa (Fletcher, 1919). Subramaniam (1922) also noted it as a minor pest in Bangalore on red gram, brinjal and grape

vine. Hingston (1929) reported that its favourite plants in Central India were *Cassia occidentalis* and *Aegle marmelos* though different kinds of vegetation attracted it. Usman and Puttarudriah (1955) include *Pongamia* among its host plants.

Distant (1902) mentions that in Ceylon this species as recorded by Mr. Green occurred both in the immature and adult stages on young shoots of *Erythrina lithosperma* puncturing the extremities of the shoots. Miller (1931) recorded from Malaya on groundnut (*Arachis hypogœa*), citrus species, cacao (*Theobrama cacao*), para rubber (*Hevea brasiliensis*), *Passiflora fœtida*, loofah (*Luffa acutangula*) and *Gliricidia* sp. and from Java on sweet potato and *Cassia fistula* in addition to other host plants recorded in India.

Authors have also noted on red gram, potato, brinjal and grape vine.

Life-History and Habits

To study the life-history and habits, a pair of adult bugs collected on grape vine in a garden in Hoskote, Bangalore District, during the second week of May 1954, were enclosed in a cloth bag on a tender twig of *Erythrina* plant in the laboratory compound. Eggs are deposited in linear rows of one to three on the stalk or on the dorsal surface of the leaf. They are also laid singly. The number of eggs in each row varies from 1 to 19. They are firmly glued to the substratum, touching one another at their ends in the row. The ends at the point of contact are flat. A few batches of eggs were removed along with bits of substratum and were kept for hatching in glass tubes. All the eggs hatched after incubating for 8 to 9 days.

Hatching.—The nymph hatches out by pushing open the circular lid measuring about 1 mm. in diameter. In some cases the lid remains attached to the empty egg shell. The head is first pushed out through the circular aperture and then by a series of muscular movements, the anterior part of the body is extricated when the antennæ, proboscis and legs are folded backwards along the body. Then the legs and antennæ are stretched and with the support of the legs the entire nymph extricates itself out of the egg shell. After a short period of rest, it moves away. This occupies about 15 minutes. The eggs hatch one after the other in succession in a row.

Newly-hatched nymph is very tiny and delicate in structure. It remains still constantly waving its antennæ alternately touching the surface with tips very frequently. When alarmed, runs about quickly, shaking the antennæ violently and raising the tip of its abdomen. Antennæ are longer than the body of the nymph itself. Nymphs cluster together on the tender shoots of the host plants and feed on sap by piercing their proboscis through the young fresh leaves and also just opening leaf-buds. First instar period lasts 3 to 4 days and the nymph moults for the first time.

Moulting.—Before moulting, the nymph becomes inactive and stops feeding. A longitudinal slit on the dorsal side of the thorax opens. Head and thorax are pushed out through the slit. By muscular movements the nymph extricates the body out of the skin, with the antennæ, proboscis and legs folded backwards. Subsequently, with the help of the hind legs it pushes away the old skin. The bug of the next instar stretches its antennæ and legs. The entire process of moulting occupies 5 to 10 minutes.

Second instar nymphs are also tiny, very active and are less gregarious. They show sign of scattering, collecting in 2's and 3's on various tender shoots. Fourth instar nymph is well developed and little sluggish. Soon after moulting the abdomen is flat and thin ; but day by day as the nymph feeds, it grows thicker and plumpy. The nymph when attacked or disturbed ejects at the anal end a long jet of colourless buggy odoured fluid which evaporates rapidly. Sometimes this jet is thrown to a distance of 1½′ to 2′. Nymph, securing a safe place, inserts its proboscis into the tender tissue preferably into veins and remains sucking the juice continuously when undisturbed. The inadequate supply of sap makes the leaves turgid and finally wither. The leaves in this withered state are exactly the same black colour as the nymph. The fifth instar nymph is much more sluggish. The nymphs on disturbance throw a long jet of colourless volatile alkaline fluid (pH 8). Adult is of a large-sized bug. It sits at the extreme tips of the host plant clinging to a spot with its beak in the stem and continuously drawing the sap. The bug usually occurs in pairs, a male and a female together.

During the course of rearing, first and second instar nymphs died up to 80% in the individual rearings in spite of taking much care. From third instar stage, the nymphs were reared

on brinjal plants enclosed in a cage to complete life-cycle. Eggs incubate for a period of 8 to 9 days; first instar occupies 3 to 4 days; second instar 11 to 12 days; third instar 6 to 7 days; fourth instar 9 to 14 days; fifth instar 16 to 17 days.

Self-Protection.—A combination of protective devices are exhibited in this species. Hingston (1929) has made a study in insect protection with this bug as an example. The colour of eggs hormonizes with that of the stem on which they are laid. The young nymph lifts its abdomen suggesting a sting and the flattened forelegs resemble cutting blades. The later instars escape notice as they simulate the shape and colour of the blackened leaves resulting from their damage. The grown up nymphs and adults feign death by dropping to the ground. They are further protected by the presence of the abdominal glands from which are squirted offensive secretions. The adults also exhibit a red warning colour at flight.

Description of Stages

Egg (*Photos I and II*).—The egg (2·5 mm. × 1·1 mm.) is barrel-shaped; narrower at micropylar end; dark brown; delicately mottled; dusted with fine white wavy granules which are more prominent on sides; flattened with an elongate depression at base. Chorion is hard and opaque with honeycomb design visible under microscope. At the upper end, there is a dorsal circular aperture covered by a lid which is pushed out at the time of eclosion of the nymph.

Nymph (*Photo III* : 1).—First instar (4 mm. × 1·5 mm.). Just-hatched nymph is brick-red in colour with dark abdomen, changing to shining black in about 45 minutes. Body flattened dorso-ventrally; antennæ longer than body; four-segmented; segments 1-3 of same size; dark brown; apical segment club-shaped; olive green; paler at base. Ocelli present. Proboscis 4-segmented; dorsally grooved; tip touching the second abdominal segment. At the junction of the thorax and abdomen, a whitish thick line runs transversely on the dorsal side with a break in the middle. Thorax distinct. Legs prominent; well developed and longer than the body; studded with spiny hairs. Anterior tibiæ strongly compressed laterally and dilated twice the femora; narrower at base. Abdomen flat with a distinct raised margin and tip. Margins of thorax and abdomen hairy.

Second Instar (*Photo III* : 2) (5 *mm.* × 2·2 *mm.*).—Newly-moulted nymph is deep brirk-red in colour with ashy white

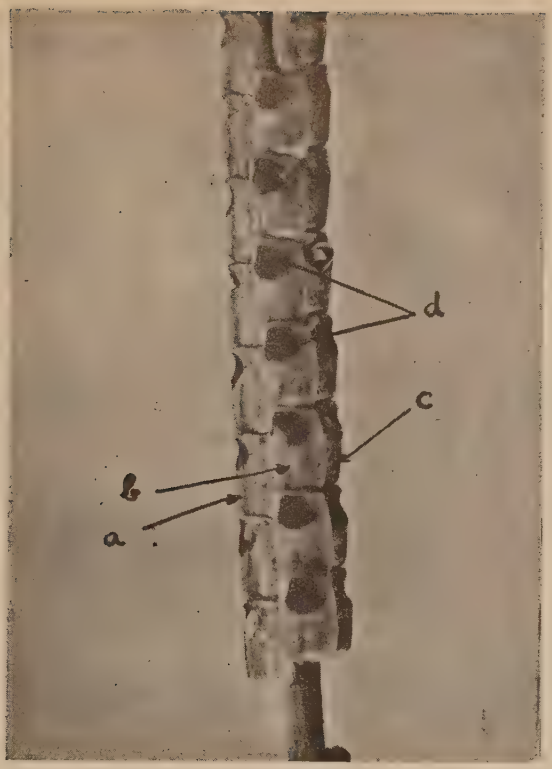

Photo I. Eggs of *Anoplocnemis phasiana* laid on the stalk of *Erythrina* leaf in three rows

a, *b*, *c*—Eggs in rows; *d*—Dorsal apertures on eggs

Photo II. Eggs of *Anoplocnemis phasiana* on leaf of *Erythrina* in single rows

a & *b*—Eggs; *b*—Eggs enlarged

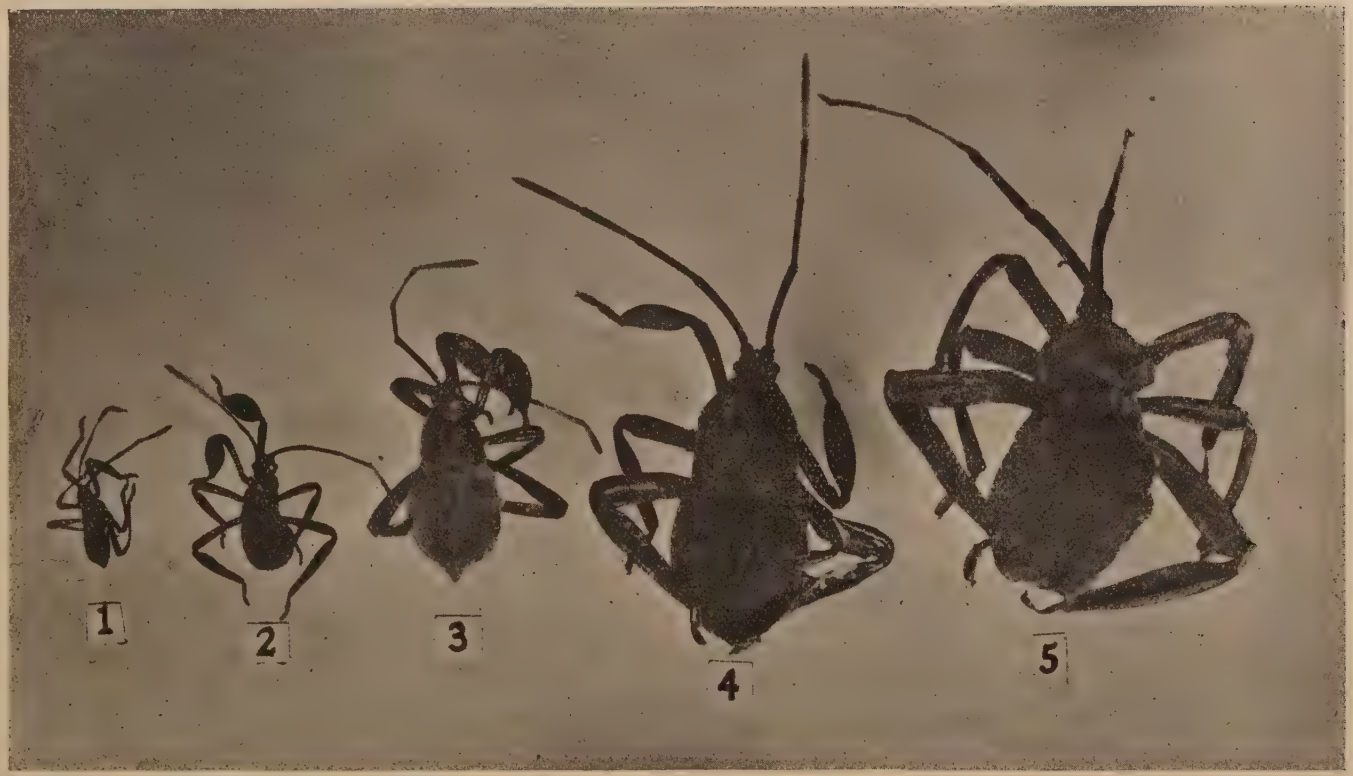

Photo III. Nymphal stages of *Anoplocnemis phasiana*

(1) First instar Nymph; (2) Second instar Nymph; (3) Third instar Nymph; (4) Fourth instar Nymph; (5) Fifth instar Nymph.

Photo IV. Adults of *Anoplocnemis phasiana*

(a) Dorsal view of male
(b) Ventral view of male
(c) Dorsal view of female
(d) Ventral view of female

Photo V. Enlarged abdominal portion with hind legs of female *Anoplocnemis phasiana*

(a) Moderately thickened posterior femora

Photo I.V Enlarged abdominal portion with hind legs of male *Anoplocnemis phasiana*

(a) Posterior femora strongly curved and thickened

abdomen which gradually changes to shining black. This is the case after every moult. This instar is distinguished from the first instar by the appearance of a narrow brownish yellow band at the base of the third antennal segment and the more prominent dilatation of the anterior tibiæ (about four times the femora). The posterior femora are feebly bent.

Third Instar (*Photo III* : 3) (10 *mm.* × 4 *mm.*).—The third instar nymph may readily be recognised by the presence of two yellowish bands on the club of the fourth antennal joint. The body shows more sclerotisation and setæ appear on whitish, very fine granular protuberances. The dilatation of the anterior tibiæ is less prominent. The wing rudiments appear externally for the first time. Two semi-circular whitish glands appear dorsally on a raised area between abdominal segments 4-5 and 5-6.

Fourth Instar (*Photo III* : 4) (13 *mm.* × 6 *mm.*).—Dorsal glands more prominent. Hind femora feebly curved and a small projection appears at the distal end. Wing pads reach second abdominal segment.

Fifth Instar (*Photo III* : 5) (18 *mm.* × 8 *mm.*).—Soon after moulting, the head, thorax and abdomen are ash-coloured and the legs are red. In about 45 to 50 minutes, the legs turn black. The colour of abdomen varies from black to brown. Ventral side of body is dark. The spiracles are also dark and their openings measure 2 mm. in diameter. Wing pads and head are ash-coloured. The wing pads extend to the fourth abdominal segment. The hind femora curved, and a prominent spine appears at the distal end. The fore-tibiæ are no longer dilated.

Adult (*Photo IV*) (25 *mm. to* 26 *mm.* × 9 *mm. to* 11 *mm.*). —The colour varies from grey to dark brown. Abdomen bright brick-red dorsally, and dark brown on the ventral side. Head small and deeply set in the large thorax. Antennæ long; four-jointed. Rostrum straight; four-jointed and reaching the mid-coxæ. Pronotum large; triangular with raised basal margins. Hemelytra cover the wings which lie flat on abdomen. Wings pale brownish or with a broad smoke-coloured violet band on apical half.

Male.—Abdomen narrow with rounded tip; posterior margin of segment two, strongly extended forming a broad median lobe having the lateral margins drawn in. Posterior femora strongly curved and thickened; anterior margin strongly and irregularly serrate; posterior margin strongly serrate in basal

half and with a broad pointed projection just beyond the middle (Photos IV and VI, *a* & *b*).

Female.—A marked sexual dimorphism is observed. Usually bigger in size than male. Abdomen broader with triangular tip, with second segment not so strongly convex. Posterior femora feebly curved and only moderately thickened and tuberculate (Photos IV and V, *c* & *d*).

Control

The application of the formulations of benzene hexachloride such as 5% BHC (with 0·6% gamma isomer), Geigy vegetable dust (0·65% Lindane) and Hexyclan has given satisfactory results in controlling the pest.

In the orchards the bugs are found to be inactive in the early mornings. It is found to be easy to make them drop into a tin by a sudden tap by hand on the twigs. The cultivators have adopted this mechanical control measure as a routine operation in the infested gardens.

Summary

Anoplocnemis phasiana Fabricius appeared as a severe pest on grape vine during 1954 round about Bangalore. It was hitherto recorded as a minor pest of legumes and other vegetables. It is widely distributed and has number of host plants of economic importance.

2. The different stages of bug are described. It moults 5 times before assuming the fully developed adult. The life-history occupies 53-63 days from egg to the adult. It offers a good example exhibiting many protective devices throughout its developmental stages.

3. Trials with BHC formulations gave good control of the pest. However, mechanical collection of bugs and their destruction has been found to be a practicable solution.

Acknowledgement

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THESE FASCINATING INSECTS

S. Usman

Silk is called "Si" in China, the traditional home of the silkworm, to immortalise the name of the Empress Si-Ling. About 4,000 years ago the Empress, while curiously examining a cocoon from her garden, dropped it accidentally into her hot cup of tea and noticed that from the softened exterior it was possible to unwind a strong and lustrous fibre in one long thread. She worked out with remarkable success the methods of recurring the silkworm caterpillars and weaving the silk thread. Thus began the silk industry. For centuries the women of China raised the silkworms at home and produred the raw silk, which, of course, involved infinite amoust of patience and a great amount of labour. As the proverb says : "Patience and the mulberry leaf become a silk gown."

The art of rearing silkworms or manufacturing silk was kept a closely guarded secret in China for hundreds of years, until about 550 A.D. two monks succeeded in smuggling into Constantinople the eggs of the silk moth concealed in a staff.

* * * *

Butterfly owes its name to the common yellow cabbage butterfly which is first seen in the early spring or butter season.

Moths and butterflies are the most attractive insects because of their beautiful colour and interesting wing patterns. According to an Indian legend God created the mountains, the streams, the valleys and the plains for the people to live in when he created them later. As an incentive for His people to love nature and seek out its beauties, He made piles and piles of marvellously coloured pebbles—reds, blues, greens, yellows and purples, representing all the colours of the rainbow. He planned to place them in the beds of all the streams. But this would hide them away. Therefore, He commanded the South Wind to breathe life into them. With this breath of life, they slowly rose and flew away—on beautiful wings which had all the colours of the rainbow.

Gardens can be cultivated with a succession of flowering plants to which butterflies are attracted. These include michaelmas daisies, cornflowers, columbine, sweet-scented mignonette,

roses and the buddleias. If some of these plants predominate, one will enjoy a procession of brightly-coloured wings.

* * * *

SCARABS (Dung Beetles) are one of the little known useful insects which are very important for public health and agriculture as scavengers and gatherers of manure.

To the ancient Egyptians the Scarab beetle was a symbol of eternal life, representing the sun-god Khapera, who was the "Creator" and the "Father of the Gods". From its habits and structures the beetle itself personified the sun because of the sharp projections on its head, which extended outward like rays of the sun ; it was also a symbol of resurrection and immortality. The fine terminal segments on each of the six legs totalled thirty and represented the days of the month, since the Egyptian Calendar was based upon a thirty-day month. The "ball" which the beetle supposedly rolled from sunrise to sunset represented the earth.

Actually, this beetle gathers manure, which it rolls into a ball in order to deposit eggs therein, so that when the eggs hatch the soft inner core of the ball supplies the food of the larvæ.

(Adapted from "Insect Fact and Folklore"—L. W. Clausen.)

CORRESPONDENCE

Further Observations on Crop Maturity

While being highly grateful to the Editor for publishing the third series of my observations on crop maturity in *Mysore Agricultural Journal*, Vol. XXXI, No. 2, April-June 1956, I am now venturing to submit figures pertaining to further studies on the foregoing subject.

Date of opening of flower	Date of harvest	Duration in days	Date of opening of flower	Date of harvest	Duration in days
Cowpea. *Vigna catjang*, 1955–56 Season.					
18—1–55	12—2–55	25	5–1–56	27–1–56	23
12—2–55	3—3–55	19	7–1–56	29–1–56	23
13—2–55	4—3–55	19	13–1–56	6–2–56	24
15—2–55	4—3–55	19	15–1–56	8–2–56	24
15–11–55	9–12–55	24	18–1–56	11–2–56	24
22–11–55	22–12–55	30	19–1–56	9–2–56	21
28–11–55	28–12–55	30	29–1–56	18–2–56	20
1–12–55	31–12–55	30	28–2–56	15–3–56	15
10–12–55	3—1–56	24	1–3–56	17–3–56	16
11–12–55	2—1–56	22	5–3–56	23–3–56	18
12–12–55	8—1–56	27	19–3–56	5–4–56	17
13–12–55	9—1–56	27	24–3–56	8–4–56	15
15–12–55	11–1–56	27			
Green-Gram. *Phaseolus radiatus.*					
10—1–56	5—2–56	26	13–2–55	10–1–56	28
Field Bean. *Dolichos lab lab.*					
2—1–55	22—2–55	51	16–1–55	15–2–55	30
8—1–55	12—2–55	35	21–1–55	18–2–55	25
10—1–55	15—2–55	36	27–1–55	22–2–55	26

Date of opening of flower	Date of harvest	Duration in days	Date of opening of flower	Date of harvest	Duration in days
Bitter Gourd. *Momordica charantia.*					
12—9–54	26—9–54	14	3–11–54	18–11–54	15
30—9–54	15–10–54	15	12–11–54	30–11–54	18
5–10–54	21–10–54	16	19–11–54	5–12–54	16
2–11–54	17–11–54	15	26–11–54	19–12–54	23

Tomato. *Lycopersicum esculentum*

17-11-54	10—1-55	54	17—1-55	4—3-55	46
10—1-55	19—2-55	40			

Mustard. *Brassica nigra.*

1—2-55	12—3-55	39	29—7-55	16—9-55	49
2—2-55	do	38	16—1-56	23—2-56	38

Castor, *Chitta haralu, Ricinus communis.*

30—7-55	10—9-55	42	5-11-55	26-12-55	51
do	13—9-55	45	4-12-55	1—2-56	59
11—8-55	23—9-55	43	23—1-56	2—3-56 to	39 to
do	28—9-55	48	12—2-56	6—3-56	43
10—9-55	19-10-55	38	23—2-56	20—3-56	37
do	21-10-55	40	18—4-56	29—3-56	35
4-10-55	12-11-55	39	8—5-56	20—5-26	31
do	14-11-55	41		8—6-56	31
do	16-11-55	43			

Gossypium arboreum. Deo'kappas.

2—2-55	22—3-55	48	26—1-56	18—3-56	52
11—2-55	29—3-55	46	20—2-56	3—4-56	43
18—2-55	6—4-55	47	24—2-56	8—4-56	44
25—2-55	11—4-55	45	2—3-56	13—4-56	42
3—3-55	17—4-55	45	7—3-56	18—4-56	42
13—3-55	29—4-55	47	16—3-56	28—4-56	43
16—3-55	1—5-55	46	23—3-56	3—5-56	41
18—3-55	2—5-55	45	3—4-56	16—5-56	43
29—3-55	13—5-55	45	14—4-56	29—5-56	46
13—4-55	2—6-55	49			

Gossypium peruvianum. Tree Cotton.

25-12-54	6—3-55	71	14—6-55	15—8-55	61
3—1-55	16—3-55	72	9-10-55	17-12-55	69
4—1-55	10—3-55	65	16-10-55	4—1-56	80
15—1-55	9—3-55	53	18—1-56	20—3-56	62
16—1-55	18—3-55	71	19—1-56	18—3-56	59
3—3-55	29—4-55	57	22—1-56	19—3-56	57
17—3-55	13—5-55	57	23—3-56	22—5-56	60
10—4-55	4—6-55	55	25—3-56	21—5-56	59
26—4-55	19—6-55	54	16—4-56	21—5-56	35
5—6-55	11—8-55	66			

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DEAR FARMERS OF MYSORE,

Mysore Farmers' Forum, hitherto The Mysore Agricultural and Experimental Union, founded by late Dr. Leslie C. Coleman, is serving the farmers of our State for the past 38 years. It extends a warm welcome to all the members of the Farmers' Forum, India, present in the nine new districts of Visala Mysore. They are invited to be our members and join hands with us to form a strong organisation of farmers in Mysore. Farmers' problems are varied and can best be solved by strengthening the association at all levels : Village, Hobli, Taluk, District and State. Regular discussions at different levels and co-operated action can help the profession of farming a great deal.

So kindly write to us and enquire with your nearest Agricultural Department Officers about this. Let your experiences benefit the farmers in general.

Yours in service,
S. V. HARIDAS,
Secretary.

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